

528 Rec'd PCT/PTO 06 APR 2000

FORM PTO-1390 (REV 11-98)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			SPM-290-A
			U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/529192
INTERNATIONAL APPLICATION NO. PCT/EP98/05982	INTERNATIONAL FILING DATE 18.09.1998	PRIORITY DATE CLAIMED 06.10.1997	
TITLE OF INVENTION METHOD AND DEVICE FOR SURFACE-TREATING SUBSTRATES			
APPLICANT(S) FOR DO/EO/US Thomas JUNG, Claus-Peter KLAGES			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). 4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (unsigned) 10. <input checked="" type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). 			
Items 11. to 16. below concern document(s) or information included:			
11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.			
12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.			
13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.			
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Our Reference: SPM-290-A

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: JUNG, Thomas and KLAGES,
Claus-Peter

Serial Number: Unknown

Filing Date: April 6, 2000

Examiner/Art Group Unit: Unknown/Unknown

Title: METHOD AND DEVICE FOR
SURFACE-TREATING
SUBSTRATES

PRELIMINARY AMENDMENT

Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

If any charges or fees must be paid in connection with the following communication, they may be paid out of our Deposit Account No. 25-0115.

Prior to initial examination, please amend the above-identified patent application as indicated below.

In the claims:

In claim 3, line 1, delete "or 2".

In claim 4, line 1, delete "one of Claims 1-3" and insert --claim 1--.

In claim 5, line 1, delete "or 4".

In claim 6, line 1, delete "one of Claims 1-5 "and insert --claim 1--.

In claim 18, line 1, delete "one of Claims 14-17" and insert --claim 14--.

In claim 21, line 1, delete "one of Claims 14-20" and insert --claim 14--.

In claim 22, line 1, delete "one of Claims 14-21" and insert --claim 14--.

REMARKS

The Amendment to the claims are based on the translated annexed claims. Claims 1-22 remain in the case. Claims 3-14, 16-18 and 21-22 are amended.

It is submitted that this Amendment has antecedent basis in the application as originally filed, including the specification, claims and drawings, and that this Amendment does not add any new subject matter to the application. Consideration of the application as amended is requested. It is submitted that this Amendment places the application in suitable condition for allowance; notice of which is requested.

If the Examiner feels that prosecution of the present application can be expedited by way of an Examiner's amendment, the Examiner is invited to contact the Applicant's attorney at the telephone number listed below.

Respectfully submitted,

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METHOD AND DEVICE FOR SURFACE-TREATMENT OF SUBSTRATES

The invention concerns a method and device for surface treatment of substrates with the aid of a gas discharge.

In surface treatment of flat substrates by means of a gas discharge, such as low-pressure glow discharges, methods are known in which the discharge is maintained by means of a microwave antenna, a high-frequency electrode, or a pulsed or timewise continuous voltage, applied to the substrate. Substrate surfaces and counter-electrodes and microwave antennas are thereby mostly arranged opposite each other.

A critical disadvantage of this method is that as a rule, only a low plasma density can be generated and the rate of plasma cleaning or plasma coating of the substrate surface is therefore low. Although the plasma density can also be increased by increasing the pressure, the associated decrease in the mean free path leads to the transport of materials to and from the substrate surface being strongly hindered. In addition, the tendency of the discharge to local contraction and instability grows. Also disadvantageous in this method is the fact that an undesirable coating of microwave-coupling windows or high-frequency electrodes arises, whereby the coupled power clearly decreases over time.

Also disadvantageous is the fact that large amounts of starting materials are thereby lost and that other internal surfaces of the vacuum chamber become coated in addition to the substrate.

Surface treatment of running metal bands, such as sheet steel or aluminum, activated or supported by an electric gas discharge, presents special problems in batch processes involving the treatment of substrates.

On the one hand, the high running speed of the band requires very high stationary coating rates and plasma densities, for sheet steel up to a rate of 100 m/min. For example, in order to deposit a coating thickness of 100 nm at a band speed of 100 m/min and a coating-zone length of 1 m, a stationary coating rate of 10 $\mu\text{m}/\text{min}$ is required. This is about 2 orders of magnitude more than can be achieved with ordinary DC or AC glow discharges.

Plasma densities as high as possible are also to be strived for in order to achieve higher deposition rates for effective removal rates for surface contaminants (oils, fats, waxes) with formation of gaseous products on a rapidly running band. Ordinary glow discharges generally do not have a sufficient degree of ionization and have too low a proportion of active species such as oxygen atoms or hydroxyl radicals.

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In addition to providing high plasma densities, production systems of this kind are expected to be able to be operated for several days without maintenance. A condition for this is that parasitic deposition of layers, i.e. the growth of layers in other places than on the sheet metal to be treated, be kept low. It should be considered that in 100 h the hypothetical "stationary" layer thickness on sheet metal at rest is up to 6 cm at a growth rate of 10 $\mu\text{m}/\text{min}$. Even if the parasitic growth rate on a counter-electrode, a deflector, or housing wall is only 1% of this value, the resulting layers with layer thickness of 600 μm would be unacceptable, since because of their internal tensions they would no longer adhere to their substrates and would disturb the coating process in the form of dislodged chips.

Starting from these and other disadvantages of the state of the art, the invention is based on the task of providing a method and a device for surface-treatment of substrates, which, in addition to high plasma densities, also provides a concentration of the high plasma densities in the immediate neighborhood of the surface to be treated, with simultaneous reduction of parasitic deposits. In addition, the coating of both moving substrates, e.g. bands, and stationary substrates is possible.

This task is solved with respect to process technology by Claim 1, and, concerning a device to perform the process, by Claim 16. The subclaims in each case give advantageous embodiments and further refinements of the invention.

In order to restrict gas discharges spatially to the surfaces to be treated, one or more electrically conducting substrates or substrates that have been coated on at least two sides to make them conducting are used so that a concentrated plasma with high plasma density is formed in the immediate neighborhood of the substrate surfaces. Through local restriction of the discharge, parasitic effects on surfaces not to be treated are strongly reduced. The discharge preferably involves a glow discharge.

The restriction of the discharge region occurs preferably on at least two essentially opposite sides, and can be, for example, in the form of a cylinder [sic, prism] with round or polygonal cross section, depending on the shape of the substrate to be coated. It is also especially appropriate to enclose it between two flat substrates arranged parallel to one another. Regardless of the shape of the enclosure, the distance between the opposite surfaces in each case should be about 1 mm to 50 cm, preferably 1 cm to 10 cm.

In addition to surface treatment of stationary substrates in a batch process, the process according to the invention is especially suitable for treating continuously moving substrates, for example, materials in the shape of a band. Here, the discharge region is restricted by having one or more substrate bands pass, at least in some regions, with a short distance from the gas discharge and thereby restrict the discharge region. Thus, for example, two bands can be fed

parallel to each other in some regions and the stationary gas discharge is enclosed by one of the band surfaces to be treated each time.

Especially advantageous is the surface treatment of one or more band-shaped substrates, which are turned while changing their direction of movement at least once and restrict the discharge region, at least on the one hand, by means of a surface region that lies before the turn in the direction of the band movement, and on the other hand, by means of a surface region that lies after the turn in the direction of the band movement. In this way, the surfaces of the band-shaped substrate to be treated pass the discharge zone at least twice each time the band is fed. A surface treatment made much more intense in this way permits an advantageous increase in the rate of movement.

The electric discharge preferably involves a discharge in the region of the hollow-cathode discharge. By this, according to the invention, is also understood a discharge in the transition region between hollow-cathode discharge and normal discharge. The entire substrate, which can be at ground potential, thereby forms the cathode. An anode, which is at a positive potential with respect to ground, is located as a counter-electrode in an appropriately selected site in the apparatus, preferably at the edge of the gas discharge. Even with a microwave-activated discharge, a hollow-cathode discharge can be constructed. The plasma then forms a "virtual" anode.

A hollow-cathode discharge is significantly more intense than an ordinary glow discharge between a cathode and an anode arranged parallel to each other. Ionization an order of magnitude higher is achieved, and significantly higher corresponding coating and removal rates are achieved. The hollow-cathode discharge is formed by use of a DC or AC voltage when the substrate surfaces restrict the discharge region to the shape of a hollow space, i.e. on at least two sides, and suitable process parameters (pressure, distance of the substrate surface, voltage, etc.) are chosen depending on the substrate geometry or the geometry of the discharge region. A hollow-cathode discharge between, e.g., two parallel plates appears as a clearly higher discharge current in comparison to the sum of the currents at each separate discharge at each of the two plates.

An electric discharge can be also realized, in addition to a DC or AC voltage, by coupling microwaves in the discharge region. For this, the discharge region defined by the substrate surface has a geometry that favors the spread of the microwaves in certain spatial regions and the formation of a gas discharge by achieving a stronger electric field. Preferably, the discharge region also has a hollow spatial geometry; in which case, the dimensions of the hollow space are adapted to the wavelengths of the microwave radiation used. As a further refinement, one can envision feeding microwaves and an electric voltage, preferably a DC voltage, into the discharge region simultaneously.

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Additional advantages and further refinements of the invention can be seen in the figures and the embodiment examples described below. Shown are:

Figure 2 shows implementation of a process according to the invention using two continuously running band-shaped substrates;

Figure 4 shows implementation of the process according to the invention using a continuously running substrate that is surrounded by a deflecting element.

The substrate 1 shown in Figures 1, 2, and 4 involves aluminum sheet metal 0.15 mm thick and 50 cm wide, in the shape of a band and supplied continuously. Other substrates, for example, steel or materials that have been coated so as to be conducting, can also be treated likewise. The substrate 1 in Figure 3 involves two stationary, parallel plates.

If the treated substrate 1 is heated too strongly, it can be cooled during surface treatment. The cooling can take place by means of a cool body through which a liquid or gaseous cooling medium flows and is in direct physical contact with the substrate. With stationary substrates, cooling can occur by means of cooling plates; and with moving substrates, by means of cooling rollers.

Substrate 1 can be grounded or connected to the ungrounded output of a voltage source. The voltage between substrate and a plasma formed by the electric discharge is preferably between 1 and 3000 V, more preferably, between 100 and 1000 V. Pulsed DC voltages with a pulse frequency between 10 kHz and 100 kHz can also be considered as DC voltages. When low-frequency AC voltages are used, the frequency is preferably between 50 and 60 Hz, and with intermediate-frequency AC voltages preferably between 10 and 100 kHz. High-frequency AC voltages preferably have frequencies between 1 and 50 MHz. Instead of or in addition to supplying power with a voltage source, it can also be supplied by microwaves. The microwave frequencies are preferably in the GHz range.

All arrangements shown in Figures 1 through 4 are, together with possible spools for winding and unwinding the band(s), placed in vacuum chambers (not shown). When band-shaped substrates are used, the substrate can also be moved to and from the discharge

region 2 by spools and vacuum locks outside the vacuum chamber. The discharge runs preferably at a pressure between 0.01 mbar and 100 mbar, especially preferably between 0.1 and 5 mbar.

Through gas lines 3 (not shown in Figures 3 and 4), inert gases such as argon, reactive gases, or even gas mixtures are introduced into the vacuum chamber. Reactive gases that can be considered include, for example, oxidizing, reducing, or carbon-containing or silicon-containing gases, such as oxygen, hydrogen, nitrogen, methane, acetylene, silane, hexamethyldisiloxane, tetramethylsilane, etc. With the aid of the reactive gases, for example, layers can be applied and materials can be removed, or gaseous components can be integrated into the surface regions. Thus, substrate surfaces can be cleaned of impurities such as lubricants, corrosion-protection agents, or oxide layers, or can be provided with corrosion-protection layers, adhesive layers for subsequent coatings, anti-friction layers to improve shaping properties, or decorative layers.

Gas removal lines 4 (not shown in Figures 3 and 4) from the vacuum chamber assure that products that might be deposited or applied from the discharge zone are removed without an opportunity to become deposited or applied parasitically.

Another possibility for reducing parasitic effects consists of arranging deflection elements, of sheet metal, for example, in the vacuum chamber. These deflection elements are electrically isolated from the components of the device and from the substrate in those regions of the vacuum chamber (chamber walls, flanges, etc.), where parasitic discharges could form because of the existing potentials, or else they enclose the discharge region and the substrate. In Figure 4, a deflection element of this kind is shown in the form of a metal cage 8.

Finally, other deflection elements, electrically isolated from device components and substrates, permit the sides of the discharge region that do not adjoin the substrate surfaces to be sealed. Cracks remaining between these deflection elements and the substrates can be closed with an insulating material (oxide ceramic, heat-resistant plastic). By this means, it can be assured that only a small number of charge carriers can escape from the hollow space of the discharge region.

The geometric dimensions of the device shown in Figures 1, 2, and 4 will be explained in the following. The diameter of the upper, thick, turning roller 5 (Figures 1 and 4) is 50 cm and the diameter of the four lower rollers 6, arranged in a rectangle, is 16 cm. The horizontal distance between the axes of the lower rollers 6 and the vertical distance between the axes of the lower rollers 6 is 19 cm and 30 cm, respectively. A volume of about 30 x 50 x 3 cm, which is especially favorable for forming a hollow-cathode glow discharge, arises between parts of the aluminum sheet metal.

Gas supply 3 occurs according to Figures 1 and 2 through a stainless-steel tube 1 cm in diameter provided with 50 holes, each 0.7 mm in diameter. This stainless-steel tube is arranged parallel to the axes of the small rollers 6. Gas removal 4 occurs through a stainless-steel tube,

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also provided with holes, below the lower pair of rollers. The stainless-steel tube for gas removal 4 has 100 2mm-diameter holes. Gas is pumped out by means of a Roots pump, which has an effective suction capacity of 500 m³/h.

In Figures 1, 2, and 4, the sheet metal 1 supplied is electrically isolated from the housing and grounded. The gas-supply tube serves as the counter-electrode (anode). Either a DC voltage source (10 to 1000 V) or an intermediate-frequency voltage source (35 kHz, 500-V peak voltage) can be used as the voltage source. In Figure 3, a hollow-cathode discharge is activated by feeding in microwaves 9.

Embodiment Example 1: Cleaning

The entering sheet metal 1 is moistened with a foam of paraffin oil (about 0.5 g/m²). The band speed is 10 m/min and the pressure is 0.5 mbar. Synthetic air (an oxygen/nitrogen mixture in a 1:4 ratio) is used as the gas with a volume flow of 4.5 m³/h. At a DC voltage of 450 V, an intense discharge is formed between the metal pieces. After passing through the discharge zone, the sheet metal has on the side 7 to be treated a surface energy of 55 dynes/cm (determined with test inks). This confirms that the oil has been completely removed.

Embodiment Example 2: Plasma polymerization

In this example, the band speed is 20 m/min and the pressure is likewise 0.5 mbar. A mixture of argon and HMDSO (hexamethyldisiloxane) is used as the gas in a 10:1 partial-pressure ratio, and a total volume flow of 70 mbar [sic, mL] x 1/s (4.2 sLm) is used. By applying an intermediate-frequency voltage (500 V), a hollow-cathode discharge is formed between the metal parts. A plasma-polymer layer with a thickness of 53 nm is deposited on the surface of the sheet metal 7. The dynamic rate (product of band speed and layer thickness) of this system is about 1060 m x nm/min. On sheet metal at rest, the deposition rate is thereby about 30 nm/s.

Embodiment Example 3: Silicization

Instead of the argon in Example 2, synthetic air is used with a volume flow of 60 mbar x 1/s. The band speed is 30 m/min. A silicon oxide layer with a thickness of 30 nm is formed. The dynamic rate is 600 m x nm/min, the static rate is 17 nm/s. The composition of the layer (according to EPMA) is SiO_{1.7}C_{0.2}. The surface energy (test inks) is over 58 dyne/cm.

Claims

1. Process for surface treatment of at least one electrically conducting substrate or a substrate that has been coated so as to be conducting, by means of a gas placed in the region of

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Amended Claims

1. Process for surface treatment of at least one electrically conducting substrate (1) or a substrate that has been coated so as to be conducting, by means of a gas placed in the region of an electric discharge, wherein the discharge zone (2) is restricted on at least two opposite sides by surfaces to be treated (7), characterized in that the one or more substrates (1) form a hollow cathode.

2. Process according to Claim 1, characterized by the fact that the substrate surface (7) is treated by a hollow-cathode discharge.

3. Process according to Claim 1 or 2, characterized by the fact that one or more continuously supplied substrates (1) can be fed to restrict the discharge region (2), at least in some regions.

4. Process according to one of Claims 1-3, characterized by the fact that band-shaped substrates are treated.

5. Process according to Claim 3 or 4, characterized by the fact that at least one of the substrates (1) supplied is turned at least once to change the direction of movement and the discharge region (2) is restricted on at least one side by substrate regions before the turn (5) in the direction of movement and on at least one other side by substrate regions after the turn (5) in the direction of movement.

6. Process according to one of Claims 1-5, characterized by the fact that the discharge region (2) is restricted on two sides by substrate surfaces at a distance of 1 mm to 50 cm apart.

7. Process according to one of Claims 1-6, characterized by the fact that the electric discharge occurs at a pressure between 0.01 mbar and 100 mbar.

8. Process according to one of Claims 1-7, characterized by the fact that at least one substrate (1) is grounded.

9. A process according to one of Claims 1-8, characterized by the fact that the voltage applied between at least one substrate (1) and a plasma formed by electric discharge is 1 -3000 V.

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10. Process according to one of Claims 1-9, characterized by the fact that the discharge is activated or supported by microwaves.

11. Process according to one of Claims 1-10, characterized by the fact that the discharge is activated or supported by a dc voltage, a pulsed dc voltage, or a low-, intermediate-, or high-frequency ac voltage.

12. Process according to one of Claims 1-11, characterized by the fact that gas is fed into the discharge region (2) or immediately outside it.

13. Process according to one of Claims 1-12, characterized by the fact that gas is removed from the discharge region (2) or immediately outside it.

14. Device for implementing the process according to one of Claims 1-13, with: at least one substrate (1) that defines a discharge region (2) enclosed on at least two sides by substrate surfaces (7), a device for supplying electrical energy to the discharge region, a vacuum chamber to enclose the discharge region, a means (3) for supplying gas to the vacuum chamber, a means (4) for removing gas from the vacuum chamber and an anode placed in the region of the substrate (1) and in that the substrate (1) forms a hollow cathode..

15. Device according to Claim 14, characterized by the fact that substrate-cooling is provided.

16. Device according to one of Claims 14 or 15, characterized by the fact that gas supply (3) is arranged in the discharge region (2) or immediately outside it.

17. Device according to one of Claims 14-16, characterized by the fact that gas removal (4) is arranged in the discharge region (2) or immediately outside it.

18. Device according to one of Claims 14-17, characterized by the fact that at least one substrate (1) is a continuously running band that can be unwound from a first spool and wound onto a second spool.

19. Device according to Claim 18, characterized by the fact that the spools are arranged outside the vacuum chamber and the band can be introduced into and removed from the vacuum chamber by vacuum locks.

20. Device according to Claim 18, characterized by the fact that the spools are arranged inside the vacuum chamber.

21. Device according to one of Claims 14-20, characterized by the fact that in the vacuum chamber, in the region of the sides of the discharge region (2) not restricted by the substrate surfaces (7), deflection elements are arranged that are electrically isolated from the device components and at least one substrate (1).

22. Device according to one of Claims 14-21, characterized by the fact that in the vacuum chamber, deflection elements are arranged in the regions of device components in which parasitic discharges could be formed due to their potentials, or around the substrate (1) and the

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discharge region (2), and that these deflection elements are electrically isolated from the device components and the substrate (1).

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Abstract

The invention concerns a method for surface treatment of at least one electrically conducting substrate or a substrate that has been coated so as to be conducting (1) by means of a gas placed in the region of an electric discharge (2). The discharge region is restricted by at least two essentially opposite sides of the substrate surface to be treated (7). This process is especially suitable for treating band-shaped and continuously supplied substrates.

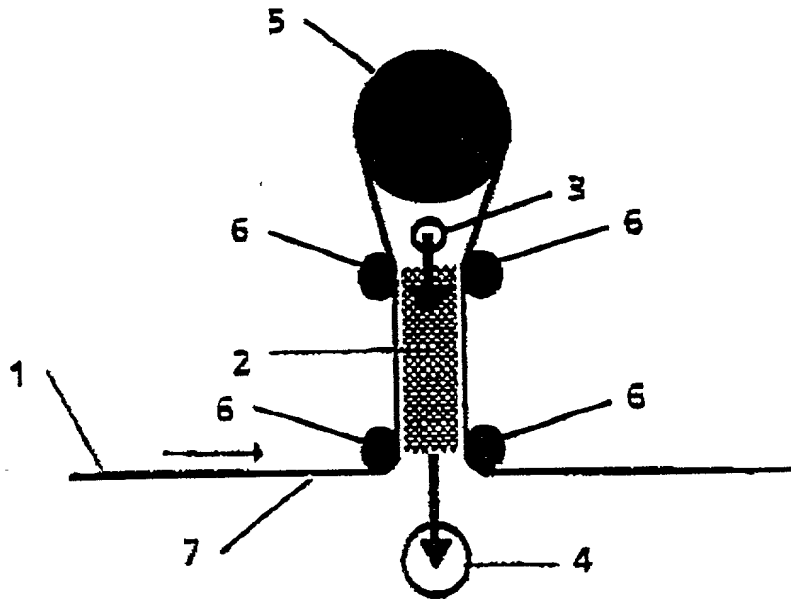


Figure 1

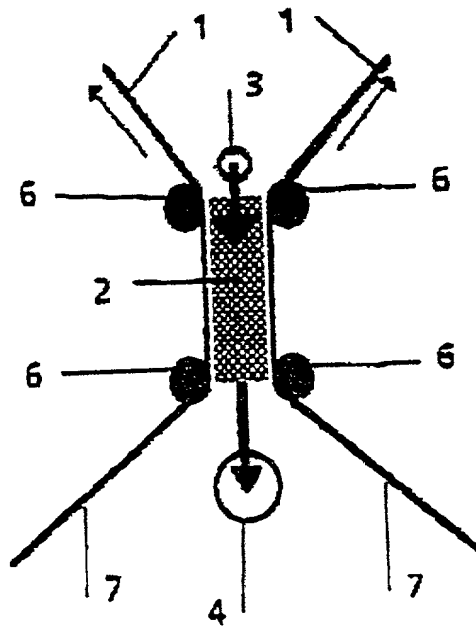


Figure 2

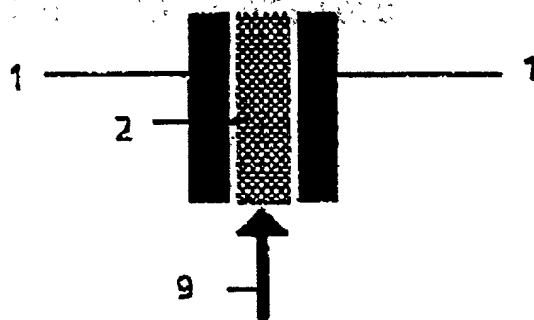


Figure 3

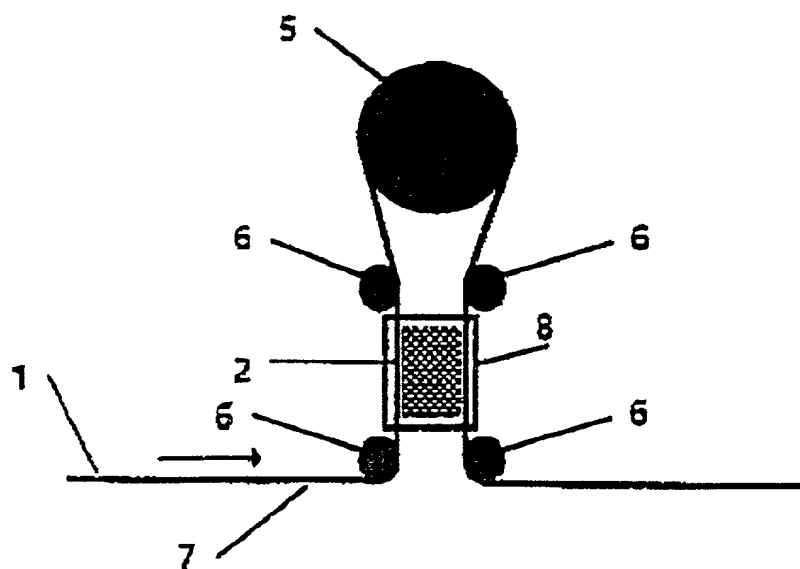


Figure 4

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Declaration and Power of Attorney for Patent Application

Erklärung für Patentanmeldungen mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

daß mein Wohnsitz, meine Postanschrift und meine Staatsangehörigkeit den im nachstehenden nach meinem Namen aufgeführten Angaben entsprechen, daß ich nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent für die Erfindung mit folgendem Titel beantragt wird:

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

VERFAHREN UND VORRICHTUNG ZUR OBERFLÄCHENBEHANDLUNG VON SUBSTRATEN

METHOD AND DEVICE FOR SURFACE- TREATING SUBSTRATES

deren Beschreibung hier beigefügt ist, es sei denn (in diesem Falle Zutreffendes bitte ankreuzen), diese Erfindung.

the specification of which is attached hereto unless the following box is checked:

- ☐ wurde angemeldet am _____
unter der US-Anmeldenummer oder unter der
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Vertrags über die Zusammenarbeit auf dem Gebiet
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- ☒ was filed on 18/09/1998
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Ich bestätige hiermit, daß ich den Inhalt der oben angegebenen Patentanmeldung, einschließlich der Ansprüche, die eventuell durch einen oben erwähnten Zusatzantrag abgeändert wurde, durchgesehen und verstanden habe.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung jeglicher Informationen an, die zur Prüfung der Patentfähigkeit in Einklang mit Titel 37, Code of Federal Regulations, § 1.56 von Belang sind.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

[Page 1 of 3]

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Prior Foreign Applications (Frühere ausländische Anmeldungen)

197 44 060 6 GERMANY
(Number) (Country)
(Nummer) (Land)

(Number) (Country)
(Nummer) (Land)

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

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(Application No.) (Filing Date)
(Aktenzeichen) (Anmeldetag)

Ich beanspruche hiermit die mir unter Title 35, US-Code, § 120 zustehenden Vorteile aller unten aufgeführten US-Patentanmeldungen bzw. § 365(c) aller PCT internationalen Anmeldungen, welche die Vereinigten Staaten von Amerika benennen, und erkenne, insofern der Gegenstand eines jeden früheren Anspruchs dieser Patentanmeldung nicht in einer US-Patentanmeldung, bzw. PCT internationalen Anmeldung in in einer gemäß dem ersten Absatz von Title 35, US-Code, § 112 vorgeschriebenen Art und Weise offenbart wurde, meine Pflicht zur Offenbarung jeglicher Informationen an, die zur Prüfung der Patentfähigkeit in Einklang mit Title 37, Code of Federal Regulations, § 1.56 von Belang sind und die im Zeitraum zwischen dem Anmeldetag der früheren Patentanmeldung und dem nationalen oder im Rahmen des Vertrags über die Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) gültigen internationalen Anmeldetags bekannt geworden sind.

(Application No.) (Filing Date)
(Aktenzeichen) (Anmeldetag)

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Ich erkläre hiermit, daß alle in der vorliegenden Erklärung von mir gemachten Angaben nach bestem Wissen und Gewissen der Wahrheit entsprechen, und ferner daß ich diese eidesstattliche Erklärung in Kenntnis dessen ablege, daß wissentlich und vorsätzlich falsche Angaben oder dergleichen gemäß § 1001, Title 18 des US-Code strafbar sind und mit Geldstrafe und/oder Gefängnis bestraft werden können und daß derartige wissentlich und vorsätzlich falsche Angaben die Rechtswirksamkeit der vorliegenden Patentanmeldung oder eines aufgrund deren erteilten Patentes geführten können.

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Priority Not Claimed
Priorität nicht beansprucht

6/10/1997
(Day/Month/Year Filed)
(Tag/Monat/Jahr der Anmeldung)

(Day/Month/Year Filed)
(Tag/Monat/Jahr der Anmeldung)

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(Status) (patented, pending, abandoned)
(Status) (patentiert, schwebend, aufgegeben)

(Status) (patented, pending, abandoned)
(Status) (patentiert, schwebend, aufgegeben)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

Andrew R. Basile; 24753
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Thomas D. Helmholdt 33181
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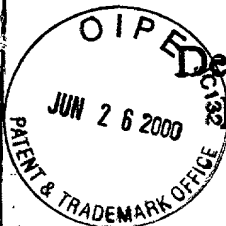
Direct Telephone Calls to: (name and telephone number)

Vor- und Zuname des einzigen oder ersten Erfinders		Full name of sole or first inventor JUNG, Thomas	
Unterschrift des Erfinders	Datum	Inventor's signature	Date
Wohnsitz		Residence Im Kamp 14 D-38173 Hötzum Germany	
Staatsangehörigkeit		Citizenship German	
Postanschrift		Post Office Address Same as above	
Vor- und Zuname des zweiten Miterfinders (falls zutreffend)		Full name of second joint inventor, if any KLAGES, Claus-Peter	
Unterschrift des zweiten Erfinders	Datum	Second Inventor's signature	Date
Wohnsitz		Residence Lützowstrasse 1 D-38102 Braunschweig Germany	
Staatsangehörigkeit		Citizenship German	
Postanschrift		Post Office Address Same as above	

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Declaration and Power of Attorney for Patent Application

Erklärung für Patentanmeldungen mit Vollmacht

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VERFAHREN UND VORRICHTUNG ZUR OBERFLÄCHENBEHANDLUNG VON SUBSTRATEN

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Ich erkenne meine Pflicht zur Offenbarung jeglicher Informationen an, die zur Prüfung der Patentfähigkeit in Einklang mit Titel 37, Code of Federal Regulations, § 1.56 von Belang sind.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND DEVICE FOR SURFACE- TREATING SUBSTRATES

the specification of which is attached hereto unless the following box is checked:

- ☒ was filed on 18/09/1998 as United States Application Number or PCT International Application Number PCT/EP98/05982 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

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(Page 1 of 3)

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Prior Foreign Applications
(Frühere ausländische Anmeldungen)

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PTO/SB/163 (2-95)

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 248-649-3333

Telefonische Auskünfte: (Name und Telefonnummer)

Direct Telephone Calls to: (name and telephone number)

Vor- und Zuname des einzigen oder ersten Erfinders 1-00	Full name of sole or first inventor JUNG, Thomas
Unterschrift des Erfinders Datum	Inventor's signature <i>Thomas Jung</i> Date April 25, 2000
Wohnsitz	Residence Im Kamp 14 D-38173 Hötzum Germany DEX
Staatsangehörigkeit	Citizenship German
Postanschrift	Post Office Address Same as above
Vor- und Zuname des zweiten Miterfinders (falls zutreffend) 2-00	Full name of second joint inventor, if any KLAGES, Claus-Peter
Unterschrift des zweiten Erfinders Datum	Second Inventor's signature <i>Claus-Peter Klagés</i> Date April 25, 2000
Wohnsitz	Residence Lützowstrasse 1 D-38102 Braunschweig Germany DEX
Staatsangehörigkeit	Citizenship German
Postanschrift	Post Office Address Same as above

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